



Lower Columbia
Estuary
Partnership

Lower Columbia Thermal Refuge Study 2016 Monitoring Results

**Estuary Partnership
Science Work Group
February 2017**

Thermal Refuge Study Objectives

Year 1 (2014 – 2015)

- Document summer stream conditions for 15 lower Columbia Gorge tributaries at and near their Columbia R. confluence zones:
 - Stream temperature
 - Confluence temperature (cold water plume formation)
 - Stream discharge
 - Fish presence (qualitative)

Year 2 (2016)

- Document summer stream conditions for subset of lower Gorge tributaries (compare to 2015 results)
- Document summer mainstem temperatures, Longview – Bonneville
- Document cold water plume characteristics at major tributaries, Longview - Bonneville (Cowlitz, Lewis, Kalama, Sandy, Washougal rivers)

2016 Gorge Tributary Monitoring Objectives

Compare summer stream temps. for 2015 versus 2016

- 3 streams: Bridal Veil, Tanner, Hardy creeks

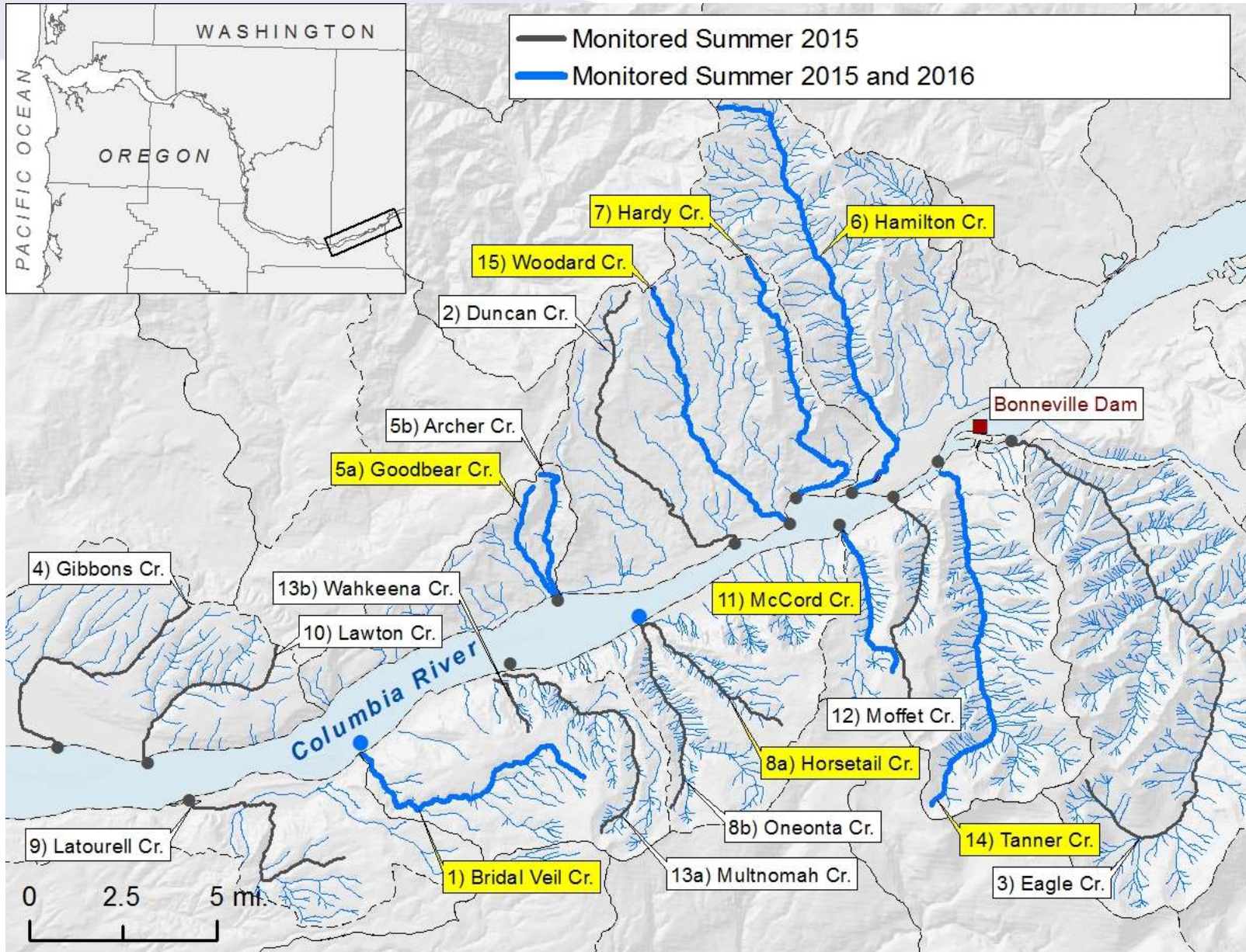
Compare dry out periods of low flow streams for 2015 versus 2016

- 3 streams: McCord, Goodbear/Archer, Woodard creeks

Limited observation of fish use at tributary confluences identified in 2015 study

- 2 streams: Horsetail, Bridal Veil creeks
- Snorkel surveys at confluence zones

2016 Gorge Tributary Monitoring Study Area



2016 Gorge Tributary Monitoring

Stream Temperature comparison

Bridal Veil and Hardy Creeks – sensors in same location both years.
Valid comparison

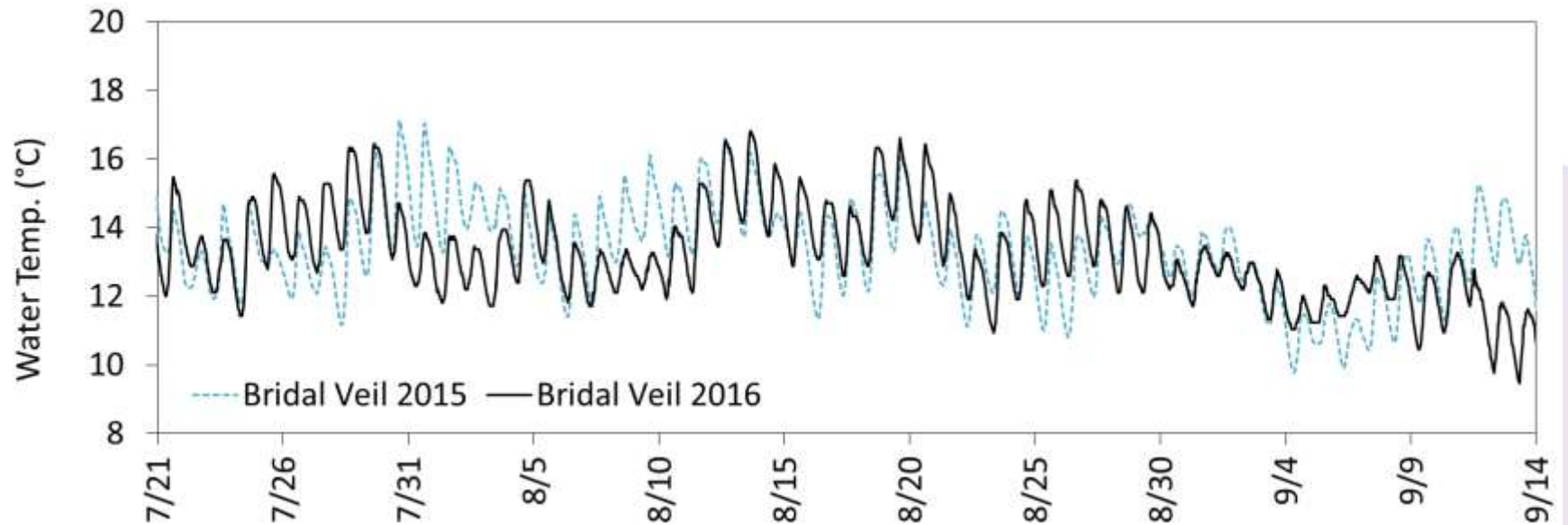
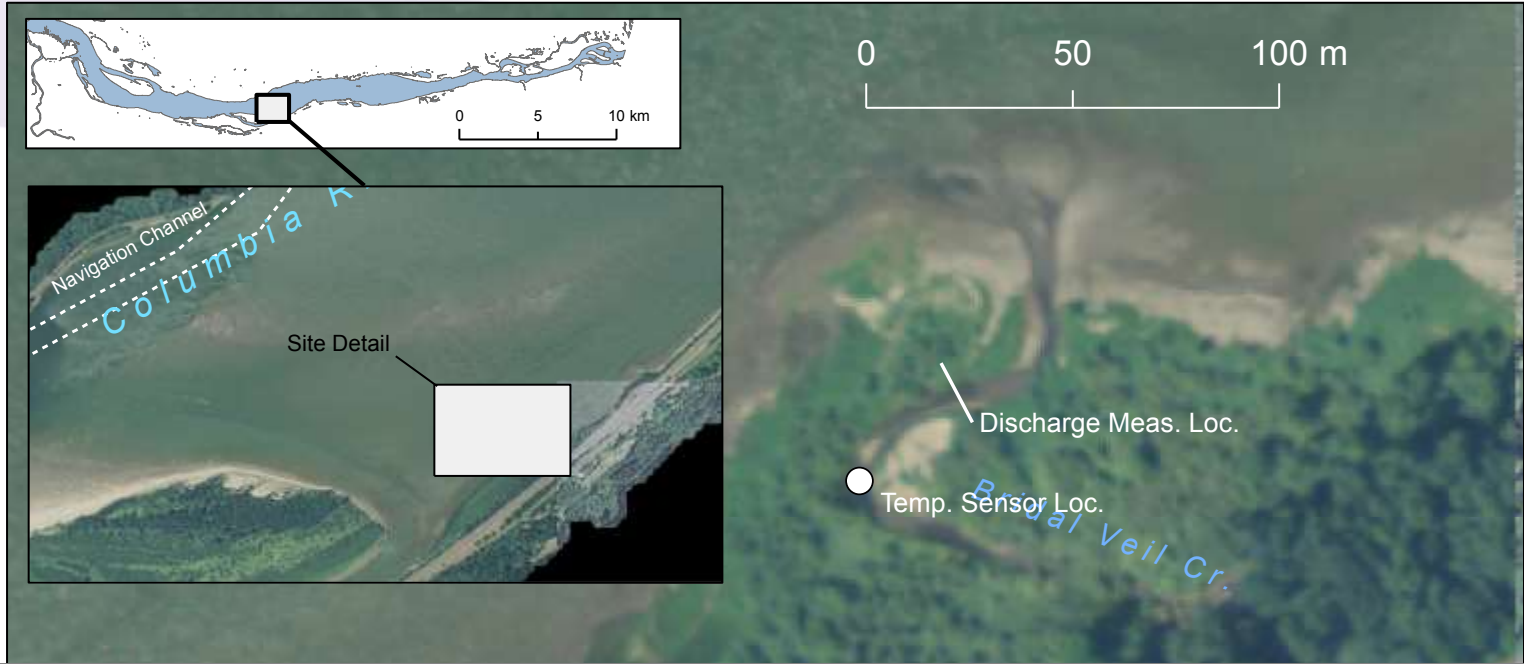
****Tanner Creek:**

2015 data is Upstream (above hatchery diversion). Downstream sensor was lost.

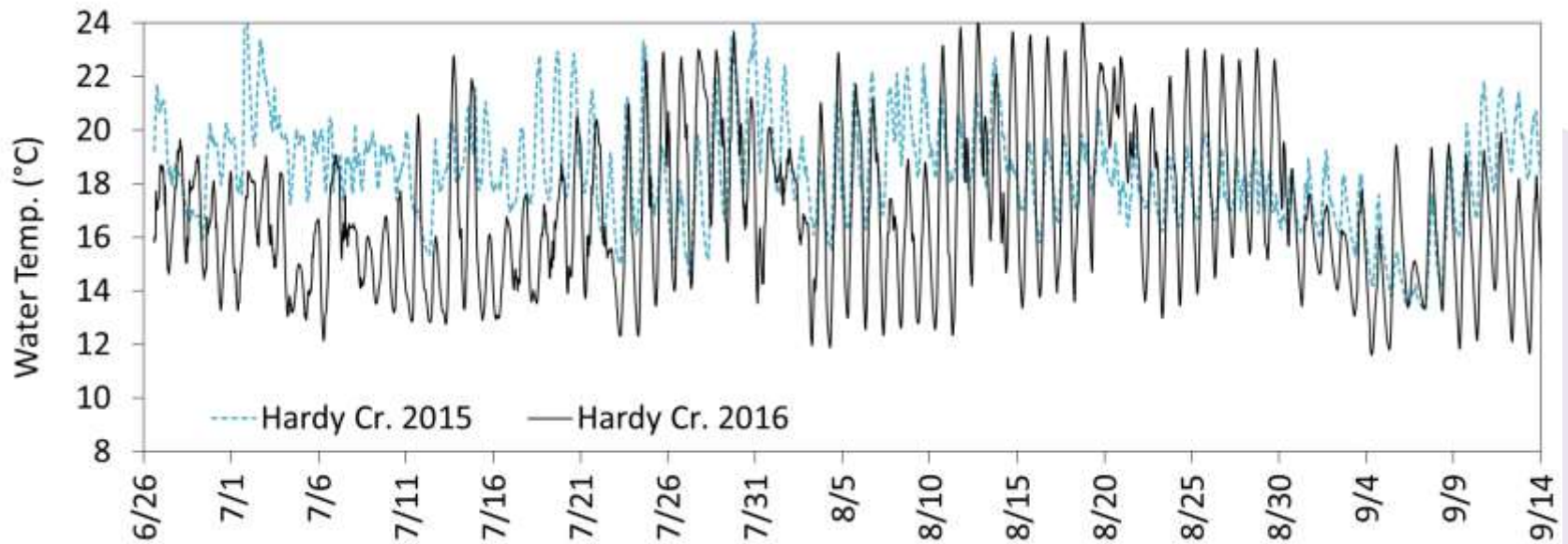
2016 data is downstream (below hatchery diversion). Upstream sensor failed.

****May not be valid comparison.**

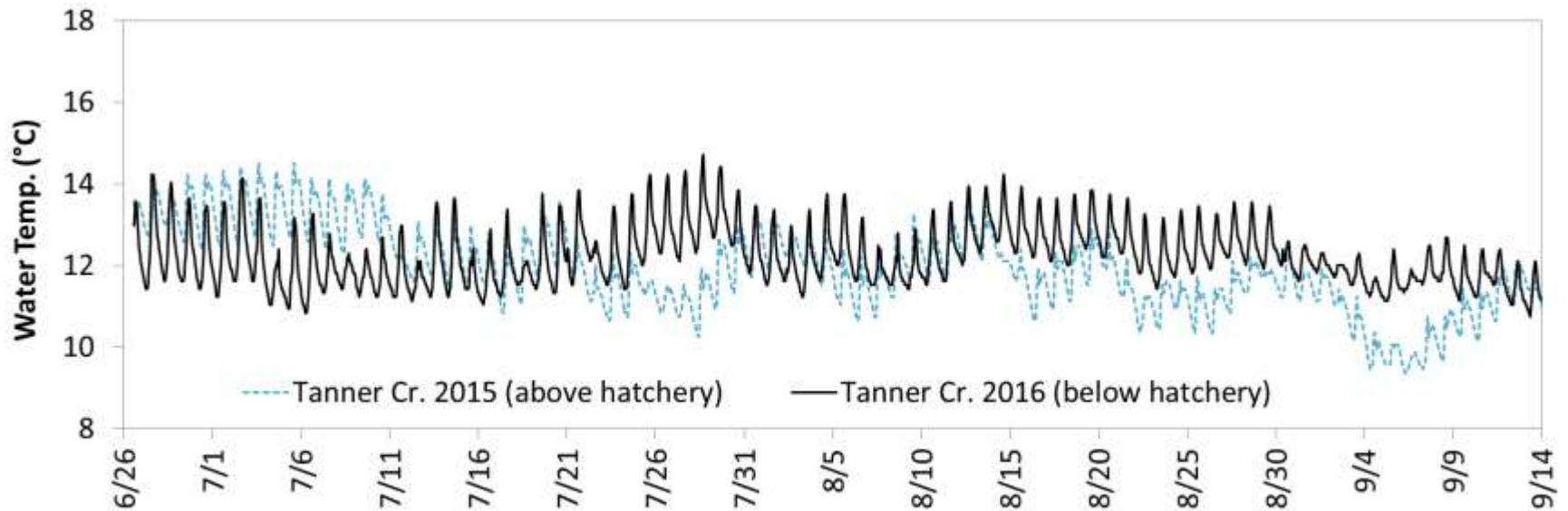
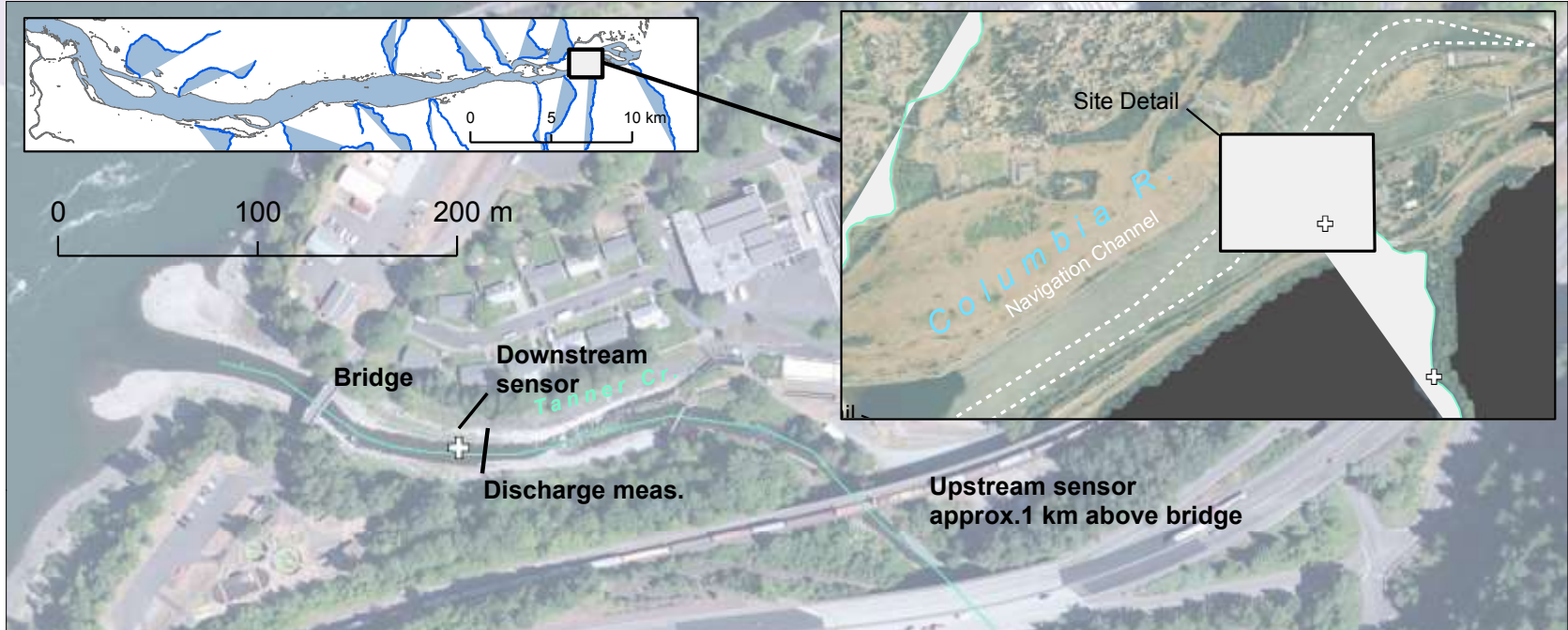
Stream Temperature Comparison. Preliminary Results: Bridal Veil Cr.



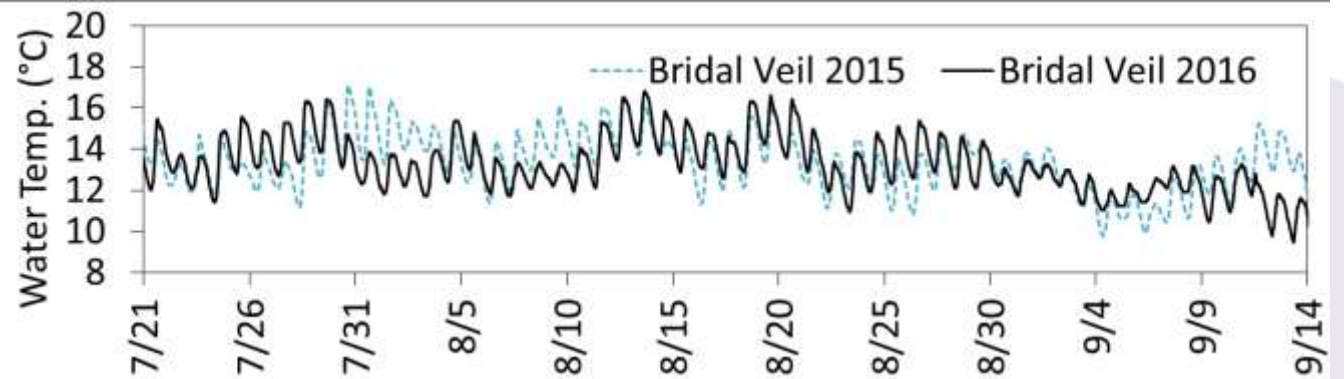
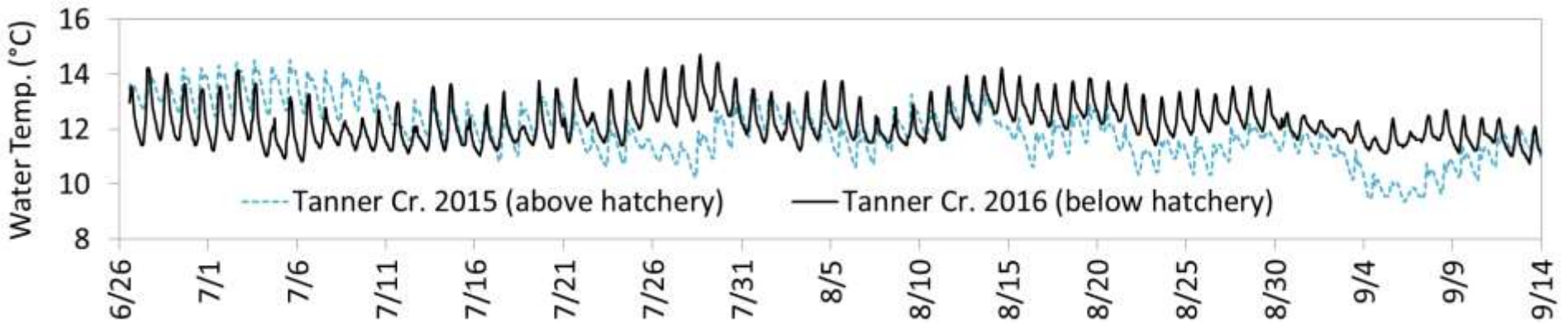
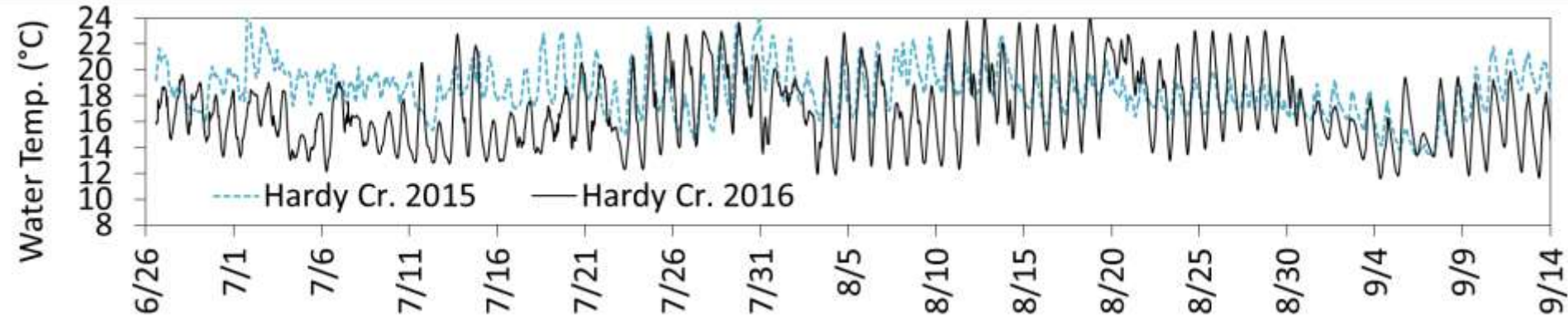
Stream Temperature Comparison. Preliminary Results: Hardy Cr.



Stream Temperature Comparison. Preliminary Results: Tanner Cr.

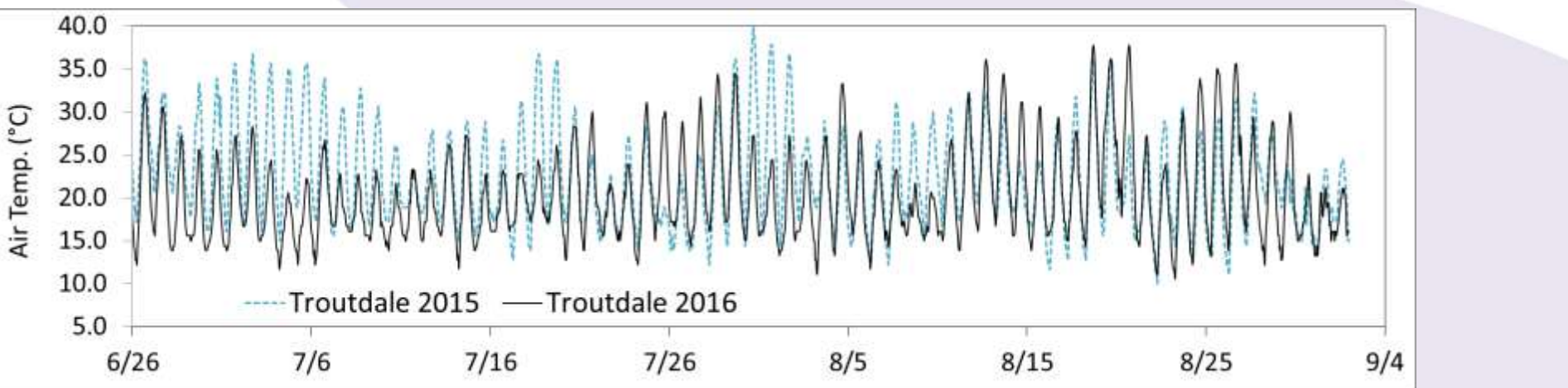
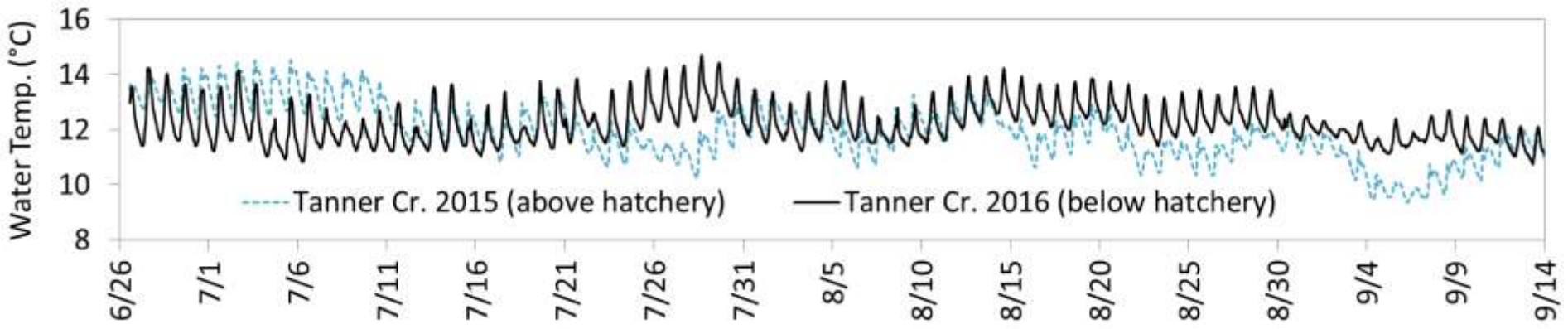
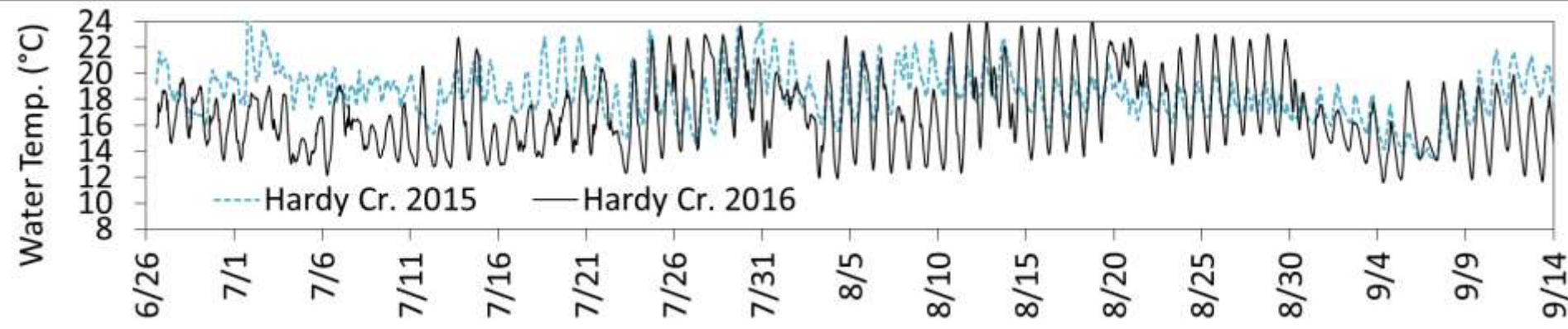


Stream Temp. Comparison. Preliminary Results All Streams



- **Hardy Cr: Larger temp. variation in 2016**
- **General pattern of higher stream temps in early summer 2015**

Stream Temp Comparison w/ Atmospheric Temperatures



Stream Temperature Comparison. Preliminary Results Summary

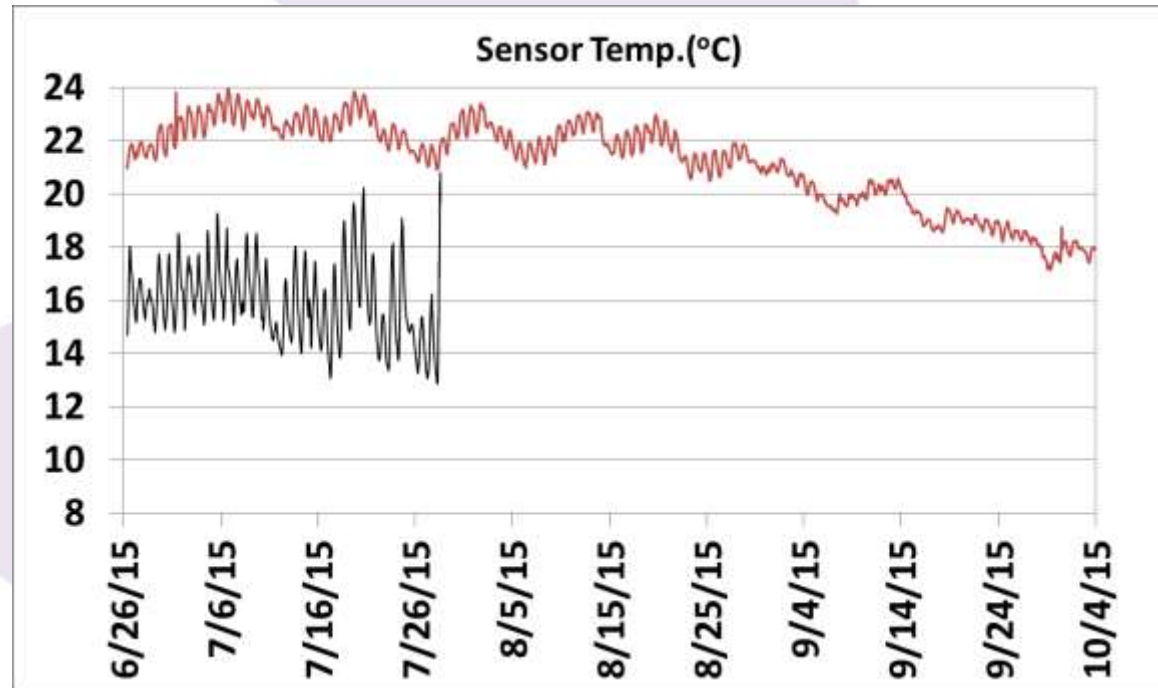
Stream	2015 Temperature			2016 Temperature		
	Min.	Avg.	Max.	Min.	Avg.	Max.
Bridal Veil (7/21 – 9/14)	9.8	13.4	17.1	9.5	13.2	16.8
Tanner (6/26 – 9/14)	10.3	12.5	14.5	10.8	12.2	14.7
Hardy (6/26 – 9/14)	13.3	18.4	*25.2	11.3	16.9	*24.3

*Exceeds thermal criteria for salmonids (19 °C threshold)

- No consistent differences between summer of 2015 and 2016
- Early summer stream temps higher in 2015, consistent with significantly warmer air temps in 2015.
- Mid and later summer temperatures were more variable between 2015 and 2016.
- Smaller discharge stream may be more consistent with atmospheric trends. But why was the diurnal variation much greater in 2016 vs. 2015?
- Need to compare stream discharges for further conclusions.

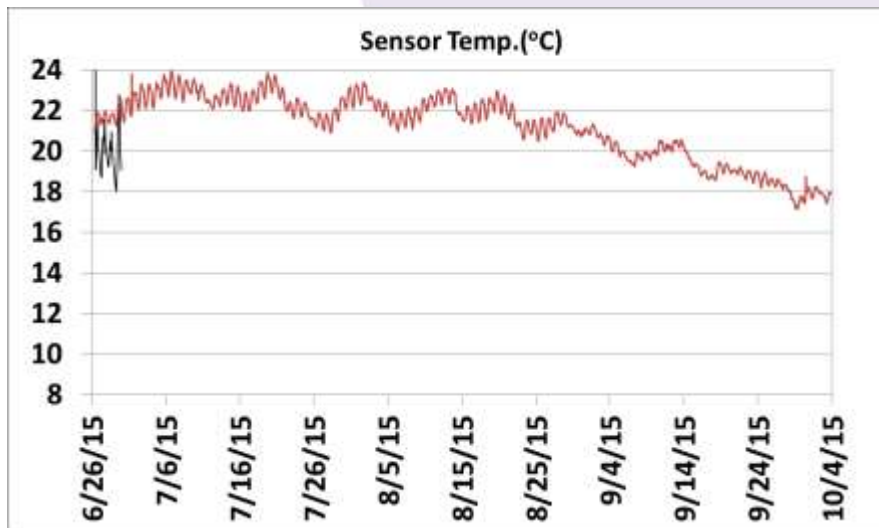
Stream Flow Comparison. Preliminary Results: Goodbear/Archer Cr.

- 2016 Sensor was lost/stolen so no data to compare.
- 2015 Data. Stream lost flow on approximately 7/28/2015.



Stream Flow Comparison. Preliminary Results: McCord Cr.

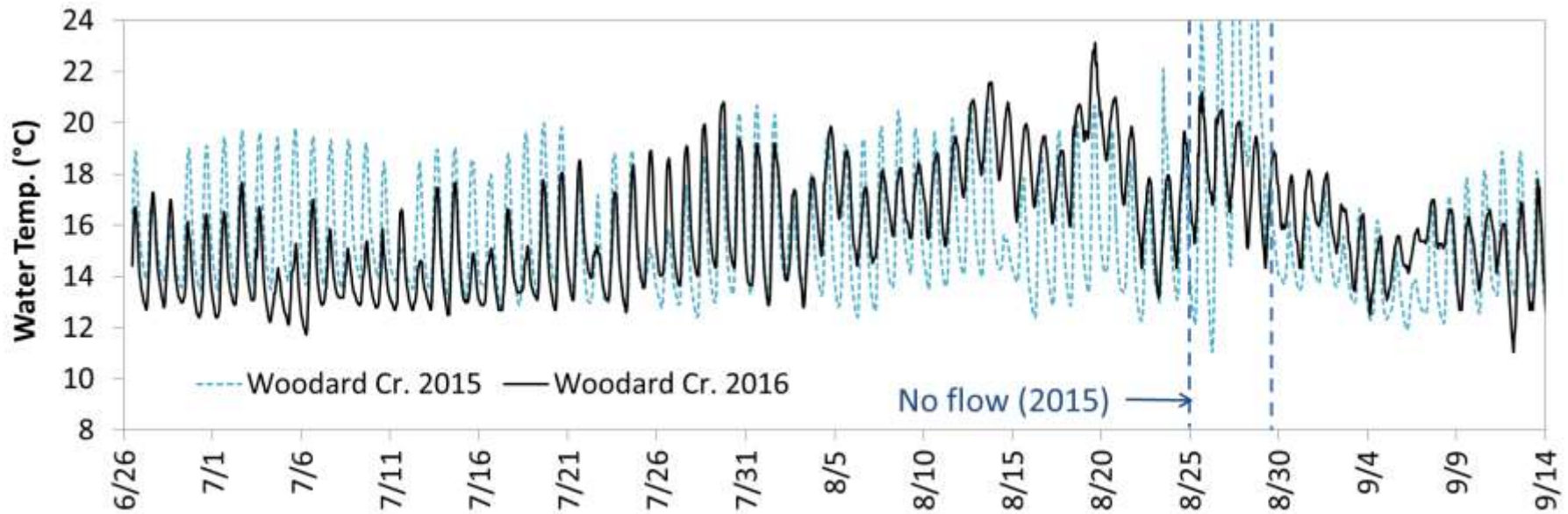
- 2015 Sensor location was dry during same week in 2016. No sensor installed in 2016.



- 2015 data. Stream dried out on approx. 6/30/15

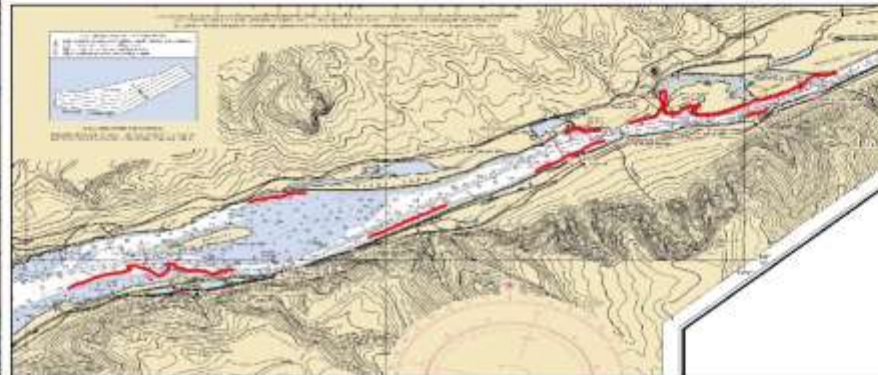
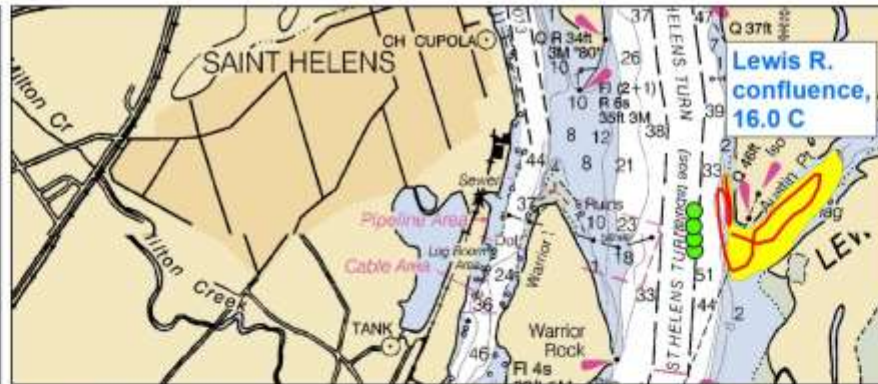
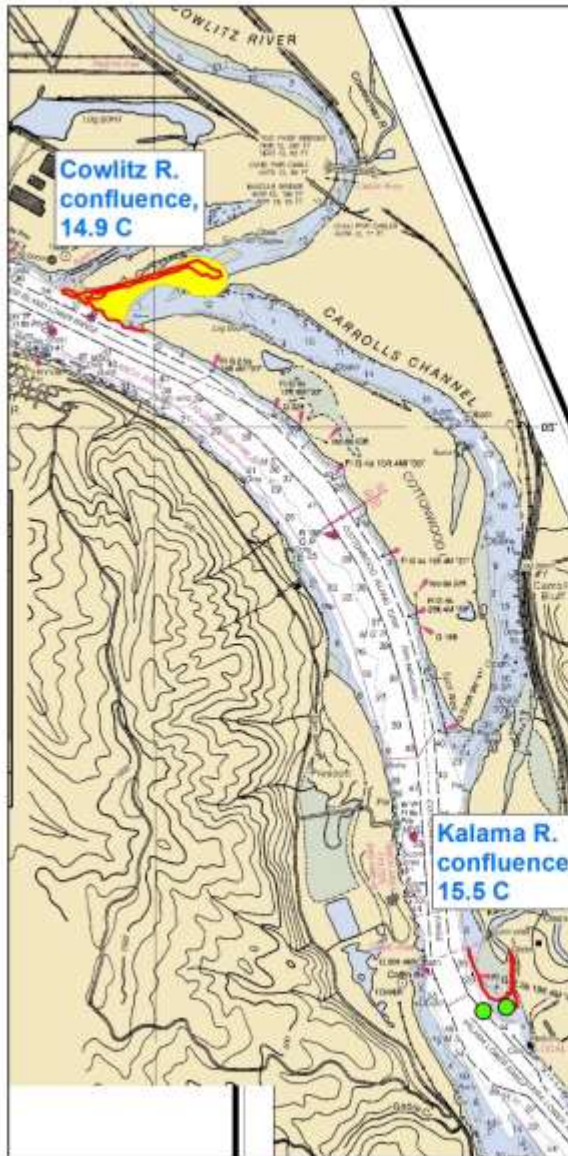
Stream Flow Comparison. Preliminary Results: Woodard Cr.

- Good data for both 2015 and 2016, but sensors were installed in different locations, so may not be conclusive.



- Stream location in 2016 did not dry out.
- Stream location in 2015 dried out from approx. 8/25 – 8/30

2016 Lower Columbia Mainstem Monitoring



Mainstem Lower Columbia Temperature Monitoring.

August 29-31 2016

- Towed Sensor Track
- Depth Survey (Hobo Sensor)

Found Cold Water:

Location,
min. temp (Celsius)

Approximate Extent

Notes:

- 1) Towed sensors at surface and approx. max. depth (up to 30')
- 2) Hobo sensors recorded temps. at deep water locations (approx. 50 - 70')
- 3) At tributary confluences, approx. extents of cold water are mapped for the confluence only (assume entire tributary upstream is cold).
- 4) Locations of cold water at Gorge tributary confluences monitored in 2015 are not shown.
- 5) Mainstem temp during surveys: 21.6 - 22.0 C

2016 Lower Columbia Mainstem Monitoring Summary

- Only Cold Water Locations found in 2016 included:
 - Cowlitz R. confluence
 - Kalama R. confluence
 - Lewis R. confluence
 - Vancouver Hatchery outlet (West of I-205 bridge. Observed adult salmonid use)
 - 2-3 small outfalls between I-5 and I-205 on WA side
- Nothing at Sandy R. or Washougal R. confluence
- **Observations are only a single point in time. Did not look at plume variations over tide cycle or with variable discharge.



**Next Steps:
Feasibility Studies for plume enhancement at
selected Gorge Tributary confluences**